Gypsy Moth News

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GypsES, A Gypsy Moth Decision-Support and Project Management System

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GypsES, the Gypsy moth Expert System, is a personal computer-based software package that is designed to assist pest management professionals. Management efforts to suppress or eradicate the gypsy moth include a complex array of tasks: surveying, gathering data, mapping data and locating potential treatment sites, and evaluating results. The GypsES software integrates tools designed to support these tasks:

- designing the layout of pheromone traps
- monitoring progress on pheromone trap placement and data collection
- analyzing pheromone trap data
- designing egg mass surveys using previously collected population survey data including defoliation survey results
- using analytical tools such as hazard rating or defoliation prediction to assess potential problems
- planning and designing of time sensitive treatment programs
- managing pesticide applications
- evaluating the effectiveness and accuracy of aerial spray operations
- evaluating the performance of personnel and contractors.

Much of the functionality of GypsES is also adaptable to other pest management projects.

USER-FRIENDLY INTERFACE

GypsES includes a user-friendly interface customized to facilitate the sequence of project planning, population surveys and monitoring, and treatment. The basis of the system is its GIS functionality. These GIS functions work with a site-specific library of spatial layers and Tagged Image File Format (TIFF), created from topographic maps (quad maps) or satellite imagery (Fig. 1-2). The GIS functions support map creation, map analysis including overlays, and on-screen digitizing. GypsES GIS functions are linked to a GypsES database and data export utilities. Population survey data entered into a database can then be analyzed spatially and used more effectively in project planning.

The interface menu of GypsES contains the following groups:

File: Basic file control functions include creating, saving, importing, exporting, and changing map layers.

Edit: Basic editing functions include editing, viewing , creating a data file, and creating or editing map layers are done here. Work windows within GypsES are areas where images, vectors, sites and raster layers can be displayed, saved as composites or output to a printer.

Figure 1.--Ortho Photo Quad--Orthophotomap (topographic)

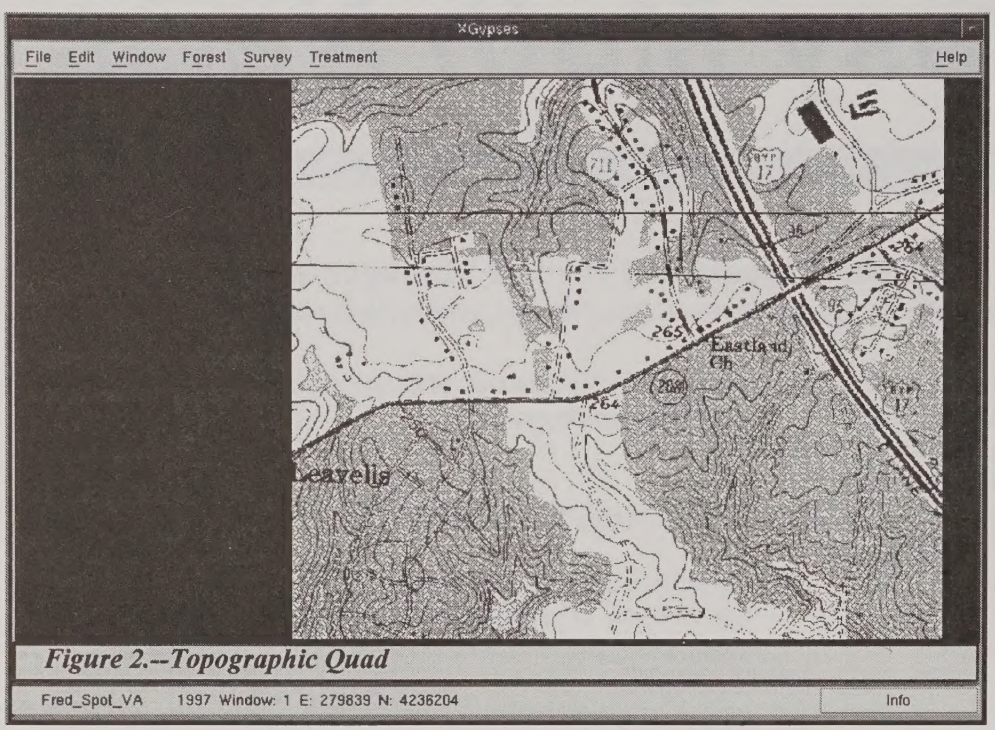

Figure 2.--Topographic Quad

Forest: Enables the creation of susceptibility and hazard maps for specific areas. Integrated research-derived models within GypsES combine information about pest population surveys, forest cover and condition to predict areas of susceptibility as well as potential for damage. A stand damage model is integrated within GypsES enabling the user to use specific forest stand conditions to predict potential losses as a result of defoliation.

Survey: Provides planning and data management for population surveys including pheromone trap grid layout. Defoliation prediction models are integrated enabling population survey data to be transformed into predicted areas of damage.

Treatment: Includes Risk, Spray Blocks, and Spray Deposit tools.

In Risk; hazard rating, defoliation prediction, and management objectives are combined to predict the risk of damage that would be unacceptable in consideration of management objectives for an area.

Spray Blocks; enables data entry related to proposed treatment areas, export of spray area map files to GPS navigation system software, and import of resulting spray flight lines.

Spray Deposit; includes the integrated spray deposition model, FSCBG. Insecticide deposit and drift can be predicted given project specific aircraft and environmental conditions.

A COLLABORATIVE EFFORT

GypsES is the outgrowth of many years of collaboration among various scientists within the USDA Forest Service's State and Private Forestry and Research; and faculty of the Pennsylvania State University, Virginia Polytechnic Institute and State University (VPI), and West Virginia University. GypsES is currently used to support pest management projects in North Carolina, Ohio, Indiana, Virginia, Tennessee, and Arkansas. Within Virginia, six county-level pest management agencies use GypsES. The National Park Service within the National Capital Region uses GypsES, as does the U.S. Air Force, Aerial Spray Unit. New users this year include the State of West Virginia; the Animal and Plant Health Inspection Service (offices in Minnesota, Washington, Indiana, Illinois, Georgia, West Virginia, and Missouri); BioServe of Sault Ste. Marie, Ontario; and Forest Protection Limited, New Brunswick, Canada.

The success of GypsES lies in capturing the tools, tasks, and information needed to support a pest management operation and integrating them such that their availability makes the operation more efficient and effective. For example, users welcome the self-contained GIS functionality of GypsES. The streamlined link to the increasingly popular GPS navigation system software within GypsES also improves the efficiency of pest management operations. The integrated models of GypsES put research products in the hands of the people who need them.

COMPUTER REQUIREMENTS

The computer requirements of GypsES include the UNIX operating system and hardware with sufficient speed and memory to handle the demands of both data and maps. GypsES is delivered to users installed and ready to use, complete with necessary map coverages needed to begin work.

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GIS, GPS, and GypsES Link Together on the Blackwater National Wildlife Refuge

Susan J. DeLost and Karen D. Felton

The Blackwater National Wildlife Refuge (NWR) is located about 10 miles south of Cambridge, MD, and is managed by the U.S. Department of Interior's Fish and Wildlife Service. The area is swampy, with scattered forest stands comprised primarily of pine, sweetgum, and oak. The area contains few natural or man-made landmarks, and there are many private in-holdings. One of the primary resource management objectives is to protect the habitat of the Delmarva fox squirrel, a threatened and endangered species. The USDA Forest Service first conducted gypsy moth egg mass surveys at the Refuge in 1989. Gypsy moth spray programs have been conducted at the Blackwater NWR since 1993.

The Blackwater NWR boundary layer was originally derived from older topographic maps, aerial photography, and estimates of approximate location made by Refuge personnel. Forest stand boundaries were also located in a similar manner, before the availability of Global Positioning System (GPS) technology. Concerns about the subjectiveness of the delineations have been answered in recent years by the use of the GPS, which has helped to precisely locate the Refuge boundary and the forest stands.

Before the use of GPS, gypsy moth spray blocks were delineated on 1:24,000 scale topographic maps, and a labor intensive effort of deploying balloons at spray block corners was necessary to help the pilot identify the treatment areas. With the advent of GPS and Geographic Information Systems, this method has been greatly improved by eliminating the need for balloons, providing a more precise means of treatment block demarcation, and providing a record of the application.

This year, 1,382 acres at the Blackwater NRW were treated with the nucleopolyhedrosis virus, Gypchek. Several of the blocks are located in areas that were acquired within the last year by the Refuge. The newly acquired areas were initially sketched onto a topographic map. The maps were digitized using pcARC/INFO GIS software, and the resulting data was added to the existing GIS data layers. Using the GIS software, spray block corner coordinates were output to a GPS-compatible file.

In preparation for the suppression project, Forest Health Protection employees travelled to the Refuge and used the coordinates stored in a GPS unit to help guide them to the general area of the blocks and to verify/correct the locations of the corners. The GPS unit used by the FHP staff is the Precision Lightweight GPS Receivers (PLGR), manufactured by Rockwell International. This unit is only available for use by Department of Defense (DoD) and other U.S. Government agencies who have set up a Communications Security Account with the DoD. The PLGR unit uses the Precise Positioning System (PPS) to remove Selective Availability and Anti-spoofing, which are security techniques used by the DoD to limit the accuracy of commercial receivers. The PPS enables the receivers to be accurate (within 5-15 meters) without differential correction, meeting our navigational needs.

The PLGR was used to navigate to each spray block corner. A Trimble Pro XL GPS unit (highly accurate after differential correction) was used to take GPS readings at each location. This application of GPS works well for a small project in the clarification of property boundaries and in the delineation of sensitive areas.

Once back in the office, the points collected on-site were transferred from the GPS unit to a personal computer. The points were differentially corrected using data from a base station at the National Geodetic Survey in Gaithersburg, MD. The base station data files were transferred to one of the Forest Service's personal computers through the Internet.

After the GPS-collected points had been differentially corrected, they were input into the GIS as a data layer. The data layer containing the original stands and blocks was compared to the GPS points and adjustments were made as needed. Using Arcview software, maps were prepared for inclusion in the Refuge's Safety Plan and Work Plan. The proposed spray block data layer was formatted for use by the Forest Service's gypsy moth expert system, GypsES. Once in GypsES, the files were reformatted for use by any of the three differential GPS navigation systems, DGPS-SATLOCK, AGNAV, or Trimble (Fig. 3).

Figure 3.--Spray block boundary and application pattern

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GypsES and GIS

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GypsES is a decision support system to help resource managers control gypsy moth. One element of the decision support system is a Geographic Information System (GIS). Since many of the activities centered around gypsy moth management are spatially referenced, utilizing a GIS with the decision support system creates a powerful tool.

The purpose of a GIS is to provide an organized method of entering, retaining, manipulating and displaying geographically referenced data. A GIS offers a visual representation of data, as each map layer represents a data element which can be viewed as a picture rather than a table of values. GIS functionality generally consists of the ability to create, edit, and delete geographically structured data; to link locational data to data tables; to analyze data spatially; and to display data.

GypsES incorporates the GRASS (Geographic Resources Analysis Support System) GIS. GRASS is a public-domain, raster-based GIS system developed and maintained (until 1996) by the U.S. Army Construction Engineering Research Laboratories (USACERL). The GRASS GIS can handle data stored as raster, vector, or site (point) layers. These are linked through the GypsES system to additional database files. GRASS 4.0, which is currently used, was released in May 1991.

GYPSES ESSENTIALS: LOCATIONS AND MAPSETS

GRASS organizes data into "locations" and "mapsets." A location identifies a specific area of interest, i.e., a county or ranger district. Geographically, the location represents a rectangle on the Earth's surface defined by the user in latitude and longitude values. GypsES transforms these values into a projection called Universal Transverse Mercator (UTM). Within a GypsES application, there may be one or more locations. A user can only interact with one location at a time, but may move between several locations during a GypsES session.

Within a location, the data layers are organized into "mapsets." A permanent mapset is used to hold the base input data, such as elevation, roads, and hydrology. Other mapsets may be created to organize work by fiscal years, spray season, or other convenient topic. For example, since the gypsy moth treatment process is an annual cycle, mapsets can be used to separate annual information, such as egg mass counts, defoliation prediction, and spray blocks for each spray season.

GYPSES ANALYSIS: TYPES OF GIS DATA

In general, there are three data types that GypsES utilizes: raster, vector, and site data.

Raster.--A raster layer is a map encoded as a regular array of cells. Each raster represents a square on the surface of the earth. The dimension of this square is called the resolution. In a raster layer, each raster is assigned an integer value. For example, in the case of elevation, the integer value represents the height above sea-level. GypsES uses the advantage of the raster layer data organization to perform operations that produce new layers by analyzing the content of existing layers. For instance, Hazard Rating examines species composition and stand age information to produce a new layer that indicates stand susceptibility. GypsES does this by examining the data values in a given raster cell for each input, and by using an algorithm or "rule" produces a susceptibility rating code for that raster in the resultant layer. All analyses within GypsES use raster layers as the basis of calculations.

Vector.--Vector layers consist of lists of UTM coordinates that define lines (in the case of roads or streams) or polygons (in the case of spray blocks). Vector data can be imported from other systems, such as from ARC/INFO or USGS Digital Line Graph (DLG) files or sketched on the screen with a mouse using the GypsES Map Edit functionality. Vector information which defines closed areas may be converted to raster form for analysis by the GypsES system.

Site Layer.--A site layer is a collection of one or more geographically located points. Site data may be displayed or used to develop raster layers, which can then be used for analysis.

GYPSES GIS: A FINAL WORD

The GIS functionality of GypsES was not designed to be a standalone system for formatting and archiving a corporate GIS system. Rather, certain elements of GRASS have been carefully chosen and cultivated to enhance the decision support capabilities of the GypsES software.

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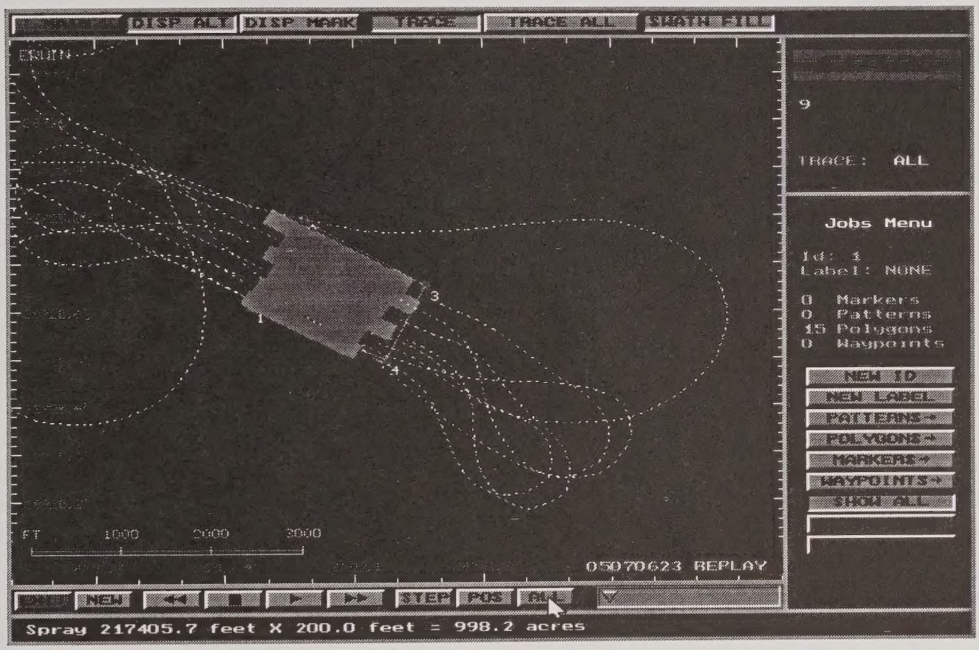
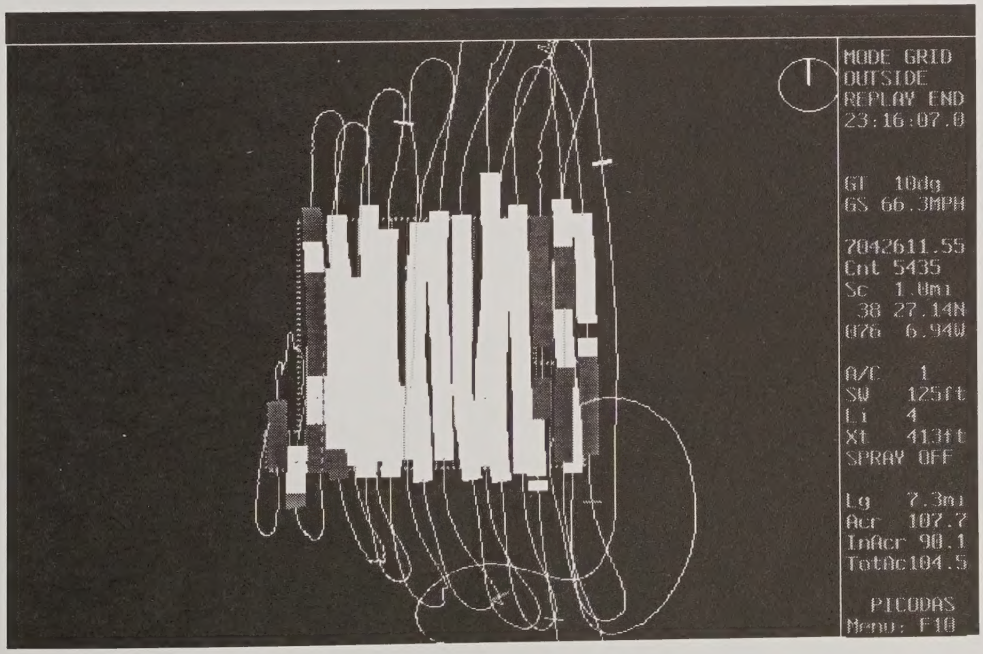
A Spray Aircraft DGPS Linked with GIS

Harold Thistle

The advent of DGPS (differential geo positioning systems) technology in spray aircraft guidance has greatly increased the applicator's ability to get material on the target. Locational technologies previously were of little use in defining the edge of a particular spray block within less than a few hundred meters. Now, 2-5 meter accuracy is easily achievable and 1 meter is typical. This allows the minimization of ground spotters and flaggers, thus reducing operational costs and exposure of humans to insecticide. Direct off-target application through mistaken visual cues is eliminated and drift damage is reduced through accurate knowledge of the position of sensitive areas surrounding the target area. As time goes on, control systems are being developed around the DGPS technology, so that such functions as spray on/off can be automated based on the DGPS positional data.

DGPS systems are now being integrated with GIS so that block and coverage information can be passed directly back and forth from on-board guidance systems to ground based systems for project planning and evaluation. The GIS being used in this application by the USDA Forest Service is GypsES, which is a large GIS-based pest management model that includes spatial analytical tools, and spray drift and pest population models.





DGPS systems have the capability of directly transferring files from onboard systems to more sophisticated GIS now in use by the USDA Forest Service. This capability allows pest managers to develop management maps on the ground using hand-held GPS units and/or almost any georeferenced photo or standard map base, move the positional data to a floppy disk, and load them directly into the system onboard the aircraft. When the aircraft has flown the area, a file of flight lines and other information, such as spray on/off, is downloaded to a floppy disk and entered directly into the ground GIS.

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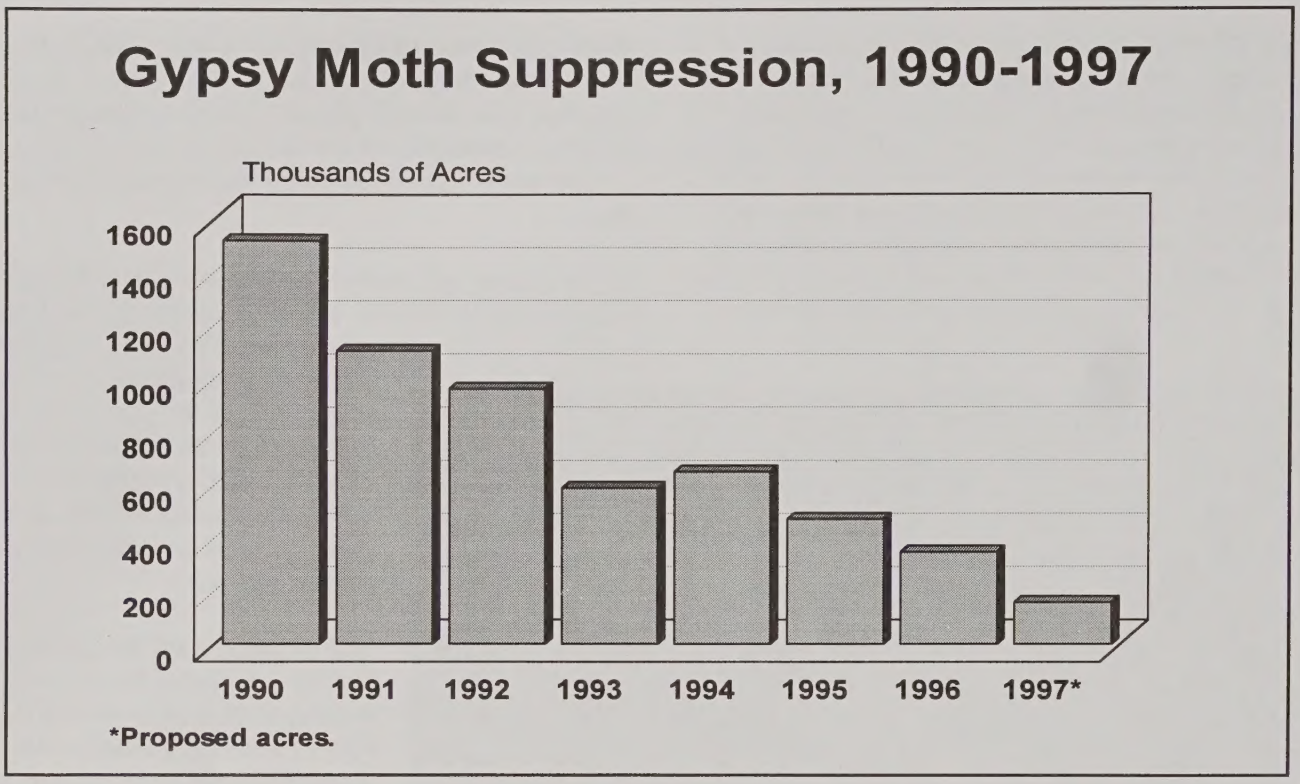
Figures 4 and 5.--Two examples of DGPS system displays, showing aircraft track and swath of material applied to treatment blocks.

Suppression Update



Gypsy moth suppression in response to potentially damaging population levels has decreased dramatically over the past 7 years. An estimated 148,272 acres were scheduled for spraying in 1997. This is the smallest suppression acreage since 1980. Michigan, Ohio, West Virginia, and Maryland account for the majority of suppression acres in 1997. In Michigan, the acreage treated continues to fall from the record 246,882 acres treated in 1992. In Wisconsin, gypsy moth populations continue to build. In 1997, an estimated 40,290 acres were treated in an attempt to eradicate gypsy moth. Though too early to predict gypsy moth populations in 1998, the combination of cool, wet springtime weather; the continued effect of the fungus, *E. maimaiga;* and spraying may help keep the gypsy moth population at low levels--especially throughout the mid-Atlantic States.

Attention Gypsy Moth Experts

We will be updating the Directory of Expertise which appeared in Issue No. 40. If we missed you the first time around or if you have any corrections, please let us know by October 1, 1997. Send us your name, organization, phone number, e-mail address, and areas of expertise related to gypsy moth at the following address:

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